NORTH PACIFIC OCEAN

By WILLIS EDWIN HURD

For the third successive month the eastern North Pacific anticyclone well maintained its average position and strength. In May its crest lay generally between the 30th and 40th parallels, but fluctuated east and west between the 130th and 165th meridians of west longitude. No depressions entered its area from the south, but lows from the Aleutian center broke into its eastern slope and lay off the California coast, central in 35° to 40° N., 135° to 140° W., on the 11th to 13th and 15th to 19th, causing unsettled weather and variable winds, but without gales, although pressures descended as low as 29.40 inches on two or three days.

The Aleutian low was somewhat more energetic than in April. This condition was not apparent while it occupied the Gulf of Alaska during the first six or seven days of the month, although moderate to fresh gales occurred near the 50th parallel, 140th to 145th meridians, on the 4th to 7th, accompanied by snow and hail squalls. The two periods of greatest intensity were those of the 8th to 13th and the 21st to 24th.

The disturbance of the earlier period was apparently a progressive cyclone of the Aleutian type. It seems to have originated not far from 40° to 45° N., 160° E., on the 8th. Thence it moved east-northeast and arrived over the central Aleutians on the 11th, after which it lost greatly in force and drifted into the Gulf of Alaska, finally moving southeastward and dissipating on the 19th near 32 N., 135° W. The cyclone acquired full storm force on the 10th, on which date the British S. S. *Tacoma* encountered a southwest gale, force 11, in 43° 48′ N., 165° 28′ E. This was the strongest wind reported for the month. The lowest pressure observed in connection with the storm was 28.83 inches, read on board the American S. S. *West Carmona*, in 43° 22′ N., 161° 06′ E., on the 9th. It is also to be noted that fresh to strong gales occurred on the 8th to 11th along the northern steamer routes between 160° E. and the Japanese coast.

The second disturbed period, that of the 21st to 24th, was characterized by gales of much less intensity, no wind forces exceeding 8 being reported. The pressure, however, gave the low estreadings of the month, with the minimum, 28.56 inches, occurring at Dutch Harbor on the 22d.

The following table of pressure data is made from the records of the various island stations, as well as from a few American coast stations. Averages are for both 8 a. m. and 8 p. m. observations, 75th meridian time, except as noted:

Station	Average pressure	Departure from normal	Highest	Date	Lowest	Date
Dutch Harbor	[2] 29.58	−0.34	30.10	3d	28.56	22d.
St. Paul [1]	[2] 29.66	−0.20	30.26	3d	28.82	22d.
Kodiak [1]	[2] 29.72	−0.15	30.24	15th	29.28	5th.
Midway Island [1]	30.09	0.00	30.18	21st [3]	29.96	4th–5th.
Honolulu	30.07	+0.01	30.17	27th	29.89	3d.
Juneau	29.93	−0.06	30.33	3d	29.45	27th.
Tatoosh Island	30.00	−0.04	30.33	2d	29.75	10th.
San Francisco	29.95	−0.03	30.13	21st	29.73	25th.
San Diego	29.94	+0.01	30.06	27th	29.73	25th.

[1] P. m. observations only.
[2] For 30 days only.
[3] And other dates.

No tropical storms have been reported as occurring during May off the lower American coast or in the Far East. Low pressure, incident to the season, prevailed off the China coast.

In the Hawaiian area the weather was largely dominated by the great anticyclone to the northward. At Honolulu, the prevailing wind was east, with a maximum velocity at the rate of 32 miles an hour from the same direction, on the 7th. This was the second highest maximum velocity ever recorded in May. The average velocity was 10 miles an hour. The rainfall was less than the normal, though the skies were well clouded, as they were during May over a considerable part of the North Pacific.

A considerable amount of fog was encountered by vessels along the northern routes in west longitudes, and between the 30th and 50th parallels in east longitudes. In the latter region there was a considerable increase in the occurrence of fog over that of April. A report from the American S. S. *West Cajoot*, Hongkong to San Francisco says: "From May 1 to May 7, inclusive, in 38° N., 153° E. to 167° W., experienced approximately 75 per cent fog, mostly low and very wet." Little fog was noted on the Asiatic or American coasts, except that it was observed on six days outside of San Francisco Harbor.

DETAILS OF THE WEATHER IN THE UNITED STATES

GENERAL CONDITIONS

A shortage of precipitation was rather general in central and eastern districts and curiously enough there were very generous rains in California, sufficiently heavy to injure the crops locally in that State.

In eastern districts an outburst of summer temperatures was experienced on the 23d–24th. This outburst was suddenly brought to a close by a wave of cool weather that swept southward on the 25th–26th. On the whole the month was warm in the West and cool in the East, the Rocky Mountains being an approximate dividing line.—*A. J. H.*

CYCLONES AND ANTICYCLONES

By W. P. DAY

The number of low-pressure areas charted during the month was less than the normal and these lows were generally of little intensity. In contrast, the high-pressure areas, though about normal in number, were important in their effects. They were also unusual in being in nearly every case of the type that pushes southward from the Canadian interior, masses of cool air of immediate polar origin. The migratory Pacific type of high, which is usually common at this season, was hardly noted. The effect of this succession of Canadian-interior highs was a series of marked depressions in temperature throughout the month, the greatest departure from the normal occurring in connection with the high of May 24–27.

FREE-AIR SUMMARY

By V. E. JAKL

Changes in free-air temperatures from day to day during the month at the various aerological stations were similar to those on the ground, except that the magnitude of these changes was as a rule less aloft than near the surface. Notwithstanding these changes, some of which

were pronounced, particularly in the lower levels, temperature departures were fairly uniform with altitude, Broken Arrow, Drexel, Ellendale, and Groesbeck showing about normal average temperatures at all altitudes observed, while at Due West and Royal Center it was uniformly slightly cooler than normal at the various levels. (See Table 1.)

Average humidities at all stations were below normal, but not sufficiently so to show any significant relation to the prevalent subnormal precipitation during the month. From this it may be inferred that the deficiency of precipitation was due not so much to lack of moisture content of the air as the lack of suitable conditions to cause ascending currents.

Resultant winds, considering both kite (Table 2) and pilot-balloon observations were approximately normal, except that the winds in the higher altitudes (above about 2,000 meters) showed a rather distinct northwesterly trend, as distinguished from the general westerly direction normal for the month at those levels. In the lower levels the winds were somewhat variable, but showed on the whole a trend mostly from the south over the Plains States and from about west over sections to the east.

In previous monthly free-air summaries mention has been made of numerous instances of weak surface pressure gradients accompanied by comparative calm near the ground and winds of strong to gale force at high altitudes. Such cases can usually be attributed to increase in pressure gradient with altitude due to latitudinal or longitudinal differences in temperature. Cases are frequently observed, however, where the wind velocity at a comparatively moderate altitude is greatly in excess of that indicated by the surface pressure gradient. In such cases, owing to the short vertical distance intervening between the surface and the altitude of the observed wind, causes other than, or in addition to, rapid change in pressure gradient with altitude are to be inferred. Such instances are in fact observed in connection with nocturnal temperature inversions, from which circumstance a partial explanation is suggested to the effect that these "inversion" winds are due to a temporary interruption of the balance between pressure gradient and deflective forces, incident to the nocturnal contraction of the air column. An example is given in the two theodolite pilot balloon observation at Drexel on the 6th, in which the wind increased steadily from 1 meter per second on the ground to 26 meters per second at 3,100 meters above the ground. More pronounced examples are shown in the single theodolite pilot balloon observations (substantially verified by kite observations) at Due West on the 4th, and Ellendale on the 15th, where the wind velocity increased from 5 m. p. s. to 26 m. p. s. in the first 800 meters, and from 3 m. p. s. to 15 m. p. s. in the first 600 meters, respectively.

In contrast to the cases just cited, the following record of a two-theodolite pilot-balloon observation made at Royal Center on the 12th shows a peculiar wind structure with altitude. This record shows winds from a general westerly direction blowing at an almost uniform velocity of 4 m. p. s. throughout a depth of air column extending from 750 meters to 6,800 meters altitude.

Altitude, m. s. l. (meters)	225 (surface)	------	500	750	1,000	1,500	2,000	2,500	3,000
Wind direction and velocity, m. p. s.	SW-2	------	W-3	W-4	SW-4	WSW-3	W-4	NW-4	WNW-4
Altitude, m. s. l. (meters)	3,500	4,000	4,500	5,000	5,500	6,000	6,800	------	------
Wind direction and velocity, m. p. s.	W-3	W-3	W-4	NW-4	NW-4	W-4	W-4	------	------

This observation was made in the north portion of a crest of high pressure having an east-west axis, the weather map furthermore showing practically no horizontal surface temperature gradient within a few hundred miles range of territory. There was undoubtedly a uniform lapse rate in temperature with altitude for some distance in all directions from Royal Center and consequently a quite uniform slope of isobaric surfaces in the immediate vicinity of Royal Center throughout the range of altitude embraced by the observation.

In this connection it is of interest to note the pilot balloon observations at Groesbeck on the 20th, 21st, and 22d, which were made on the western side of an extensive high-pressure area. Winds from a southerly to southwesterly direction, and perhaps westerly in the higher altitudes, might be inferred from the pressure situation, inasmuch as the general trend of the isobars was southwest-northeast. Actually southerly winds prevailed to only moderate altitudes, above which east component winds, varying from northeasterly on the 20th to southeasterly on the 22d, were observed. East component winds to a considerable depth were also observed on a few dates at Due West, Broken Arrow, San Francisco, and Key West. In practically all these cases, similarly to that at Groesbeck just mentioned, the observations were made near the edge of high pressure areas, indicating the tendency at the more southerly stations to east component winds at high altitudes, a tendency that becomes more and more conspicuous, irrespective of the alignment of surface pressure gradients, as the warm season advances.

The record of the kite observation at Drexel on the 19th given in the following table, is cited to show that conditions in the free air preceding heavy showers by a few hours do not necessarily include high temperature lapse rates or high humidity.

Altitude, m. s. l.	Temperature	Relative humidity	Wind direction	Wind velocity
Meters	° *C.*	*Per cent*		*M. p. s.*
396 (surface)	25.2	48	SSW.	8
1,000	19.0	54	SSW.	11
1,500	15.8	54	SW.	10
2,000	13.2	48	WSW.	9
3,000	6.4	60	WNW.	11
4,000	0.0	44	NW.	12
5,000	−5.8	29	NW.	15
6,000	−11.3	24	NW.	17

It will be noted that the lapse rate averaged about 0.65° per 100 meters throughout the range of observation, and that only medium humidities prevailed. The observed lapse rate, however, was sufficient to cause

convection and precipitation as soon as humidity reached the saturation point, which condition was probably ultimately effected by accumulation from adjoining regions. A thunderstorm with 0.55 inch rainfall followed this observation by about 3 hours.

For comparison with the preceding case, the record of the fifth flight of the diurnal kite observation series of the 22d–23d at Drexel is referred to to show a free-air condition in which, by progressive fall in temperature aloft, a dry adiabatic lapse rate prevailed from 1,000 to 3,700 meters, but no precipitation resulted and weather remained practically cloudless for the following 12 hours. During this series precipitation occurred some distance east of Drexel, where the trend of the isobars indicated drainage from a more southerly source, while at Drexel the winds at intermediate levels were from dry regions to the west.

TABLE 1.—*Free-air temperatures, humidities, and vapor pressures during May, 1925*

TEMPERATURE (°C.)

Altitude m. s. l. (meters)	Broken Arrow, Okla. (233m.)		Drexel, Nebr. (396m.)		Due West, S. C. (217m.)		Ellendale, N. Dak. (444m.)		Groesbeck, Tex. (141m.)		Royal Center, Ind. (225m.)	
	Mean	Departure from 7-yr. mean	Mean	Departure from 10-yr. mean	Mean	Departure from 5-yr. mean	Mean	Departure from 8-yr. mean	Mean	Departure from 7-yr. mean	Mean	Departure from 7-yr. mean
Surface	18.9	−0.4	15.4	−0.4	20.4	0.0	13.7	+0.7	22.0	−0.6	15.4	−1.0
250	18.8	−0.4			20.0	−0.1			21.0	−0.7	15.1	−1.0
500	16.8	−0.5	14.7	−0.4	17.2	−0.6	13.3	+0.6	19.2	−0.7	12.1	−1.4
750	15.7	−0.1	13.3	−0.1	15.3	−0.7	11.6	+0.5	18.1	−0.5	10.3	−1.3
1,000	14.8	+0.2	12.1	+0.1	13.6	−0.9	10.3	+0.7	17.3	−0.1	8.9	−1.2
1,250	14.0	+0.6	11.0	+0.4	11.7	−1.3	8.9	+0.7	16.7	+0.3	7.4	−1.1
1,500	12.9	+0.7	9.6	+0.4	10.5	−1.1	7.2	+0.5	15.6	+0.3	5.8	−1.2
2,000	10.3	+0.7	6.8	+0.2	7.4	−1.6	3.7	0.0	13.5	+0.5	3.2	−1.2
2,500	7.3	+0.4	4.3	+0.4	4.8	−1.5	0.6	−0.1	10.5	+0.2	0.3	−1.6
3,000	4.4	+0.5	1.4	+0.4	1.4	−2.0	−2.0	+0.1	7.5	0.0	−2.8	−1.9
3,500	1.0	+0.1	−1.6	+0.3	−1.6	−2.2	−4.7	0.0	4.5	0.0	−6.6	−2.8
4,000	−2.3	+0.1	−4.2	+0.6			−8.0	−.3	1.7	+0.2		
4,500	−4.9	+0.3	−6.8	+0.9			−11.6	−0.7	−0.9	+0.6		
5,000	−7.1	+0.3	−9.5	+1.2			−15.4	−1.8	−2.6	+1.5		

TABLE 1.—*Free-air temperatures, humidities, and vapor pressures during May, 1925*—Continued

RELATIVE HUMIDITY (%)

Altitude m. s. l. (meters)	Broken Arrow, Okla. (233m.)		Drexel, Nebr. (396m.)		Due West, S. C. (217m.)		Ellendale, N. Dak. (444m.)		Groesbeck, Tex. (141m.)		Royal Center, Ind. (225m.)	
	Mean	Departure from 7-yr. mean	Mean	Departure from 10-yr. mean	Mean	Departure from 5-yr. mean	Mean	Departure from 8-yr. mean	Mean	Departure from 7-yr. mean	Mean	Departure from 7-yr. mean
Surface	64	−7	59	−6	49	−14	52	−9	63	−8	58	−4
250	64	−7			50	−13			65	−6	58	−4
500	62	−7	58	−6	54	−10	52	−9	68	−4	61	−1
750	60	−9	55	−8	57	−8	51	−9	65	−6	63	+1
1,000	59	−9	55	−7	59	−6	51	−9	58	−10	63	+1
1,250	56	−10	54	−8	61	−4	51	−10	54	−10	65	+3
1,500	54	−10	54	−8	61	−4	52	−9	51	−9	66	+4
2,000	54	−8	55	−5	66	+3	57	−4	43	−10	68	+9
2,500	56	−3	55	−3	68	+6	57	−3	50	−1	75	+20
3,000	59	+3	53	−5	68	+10	50	−8	52	+2	74	+23
3,500	64	+8	56	−2	64	+11	44	−9	60	+11	92	+40
4,000	69	+11	60	+1			41	−10	67	+16		
4,500	65	+9	58	−2			39	−12	74	+21		
5,000	71	+9	58	−4			39	−9	86	+22		

VAPOR PRESSURE (*mb.*)

Altitude m. s. l. (meters)	Broken Arrow, Okla. (233m.)		Drexel, Nebr. (396m.)		Due West, S. C. (217m.)		Ellendale, N. Dak. (444m.)		Groesbeck, Tex. (141m.)		Royal Center, Ind. (225m.)	
	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal
Surface	14.31	−2.05	10.65	−1.18	11.78	−3.33	8.31	−0.98	16.69	−2.75	10.48	−1.25
250	14.17	−2.04			11.66	−3.19			16.21	−2.45	10.32	−1.20
500	12.45	−1.81	10.05	−1.13	10.73	−2.44	8.10	−0.94	15.17	−1.77	9.06	−0.79
750	11.17	−1.64	8.63	−1.20	10.12	−1.89	7.21	−0.75	13.70	−1.63	8.39	−0.36
1,000	10.44	−1.29	7.95	−0.94	9.53	−1.42	6.56	−0.65	11.51	−2.12	7.80	−0.08
1,250	9.55	−1.02	7.19	−0.87	9.00	−0.99	6.03	−0.59	10.04	−1.86	7.15	+0.05
1,500	8.55	−0.72	6.43	−0.84	8.47	−0.60	5.47	−0.54	8.77	−1.56	6.44	+0.09
2,000	7.23	−0.26	5.44	−0.34	7.68	+0.24	4.77	−0.08	6.50	−1.31	4.88	+0.01
2,500	6.09	+0.23	4.67	−0.01	6.91	+0.80	3.96	+0.13	6.06	−0.28	3.69	+0.08
3,000	5.30	+0.66	3.68	−0.11	5.51	+0.69	3.06	+0.06	5.22	−0.07	1.99	−0.50
3,500	4.56	+0.66	3.10	+0.06	3.97	+0.12	2.22	−0.02	5.25	+0.81	1.83	−0.16
4,000	3.96	+0.65	2.63	+0.17			1.71	0.00	4.68	+0.91		
4,500	3.26	+0.55	1.95	−0.04			1.46	+0.14	4.58	+1.23		
5,000	3.08	+0.55	1.56	−0.08			1.42	+0.41	4.76	+1.33		

TABLE 2.—*Free-air resultant winds (m. p. s.) during May, 1925*

Altitude, m. s. l. (meters)	Broken Arrow, Okla. (233 meters)				Drexel, Nebr. (396 meters)				Due West, S. C. (217 meters)				Ellendale, N. Dak. (444 meters)				Groesbeck, Tex. (141 meters)				Royal Center, Ind. (225 meters)			
	Mean		7-year mean		Mean		10-year mean		Mean		5-year mean		Mean		8-year mean		Mean		7-year mean		Mean		7-year mean	
	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.
Surface	S. 26°E.	1.6	S. 22°E.	1.6	S. 12°W.	1.8	S. 10°W	1.1	N. 16°W.	1.2	N. 86°W.	0.3	S. 86°W.	1.5	N. 14°E.	0.4	S. 33°E.	1.9	S. 17°E.	2.0	S. 63°W.	1.7	N. 10°W.	0.2
250	S. 24°E.	1.5	S. 22°E.	1.6					N. 19°W.	1.2	N. 88°W.	0.4					S. 21°E.	2.8	S. 11°E.	2.6	S. 57°W.	2.0	N. 27°W.	0.1
500	S.	1.9	S. 10°E.	2.2	S. 11°W.	2.1	S. 14°W.	1.2	N. 62°W.	1.9	N. 87°W.	0.4	S. 67°W.	2.0	N. 26°E.	0.2	S.	4.2	S. 3°E.	3.7	S. 64°W.	4.5	S. 63°W.	0.9
750	S. 15°W.	2.5	S.	2.6	S. 29°W.	2.3	S. 22°W.	1.3	N. 74°W.	2.4	S. 82°W.	1.4	S. 43°W.	3.2	S. 11°E.	0.5	S. 6°W.	4.4	S. 7°W.	4.2	S. 70°W.	5.4	S. 70°W.	1.5
1,000	S. 46°W.	2.9	S. 18°W.	2.8	S. 40°W.	2.3	S. 43°W.	1.9	N. 76°W.	2.7	S. 89°W.	1.9	S. 59°W.	3.2	S. 7°W.	0.8	S. 15°W.	4.8	S. 19°W.	4.6	S. 76°W.	6.5	S. 84°W.	2.1
1,250	S. 48°W.	2.9	S. 34°W.	3.0	S. 53°W.	2.0	S. 54°W.	2.2	S. 88°W.	3.6	S. 78°W.	3.0	S. 77°W.	2.8	S. 26°W.	1.1	S. 14°W.	4.5	S. 27°W.	4.8	S. 45°W.	11.4	N. 86°W.	2.6
1,500	S. 62°W.	3.7	S. 47°W.	3.4	S. 66°W.	3.4	S. 61°W.	3.1	N. 83°W.	4.6	S. 77°W.	4.1	W.	2.6	S. 36°W.	1.4	S. 15°W.	3.4	S. 36°W.	4.6	S. 77°W.	6.4	N. 88°W.	2.8
2,000	S. 64°W.	4.2	S. 66°W.	4.1	S. 76°W.	3.8	S. 75°W.	4.2	N. 86°W.	6.7	S. 82°W.	5.5	N. 77°W.	4.5	S. 57°W.	2.4	S. 25°W.	3.5	S. 48°W.	4.6	S. 83°W.	19.7	W.	5.6
2,500	S. 75°W.	4.7	S. 84°W.	5.2	S. 67°W.	4.7	S. 81°W.	4.9	N. 87°W.	11.9	S. 83°W.	7.1	N. 75°W.	6.1	S. 62°W.	3.8	S. 16°W.	2.7	S. 63°W.	5.0	W.	13.1	N. 85°W.	5.1
3,000	N. 87°W.	4.6	N. 81°W.	6.2	N. 82°W.	7.0	S. 86°W.	7.1	N. 76°W.	11.9	N. 87°W.	6.9	N. 73°W.	9.0	S. 71°W.	5.3	S. 20°W.	3.0	S. 76°W.	6.1	N. 55°W.	16.9	N. 72°W.	6.7
3,500	N. 65°W.	5.6	N. 72°W.	8.5	N. 75°W.	10.2	N. 89°W.	8.4	W.	10.0	N. 83°W.	8.4	N. 77°W.	9.4	S. 81°W.	5.8	S. 17°W.	3.5	S. 86°W.	7.0	N. 75°W.	15.4	N. 71°W.	7.6
4,000	N. 78°W.	4.0	N. 69°W.	8.6	N. 69°W.	10.1	N. 81°W.	9.1					N. 64°W.	13.6	N. 86°W.	7.1	S. 42°W.	2.6	N. 70°W.	9.6	N. 67°W.	19.1	N. 80°W.	7.2
4,500	N. 67°W.	5.8	N. 65°W.	10.8	N. 54°W.	10.2	S. 85°W.	10.0					N. 65°W.	11.5	N. 70°W.	5.7	S. 52°W.	2.2	N. 64°W.	9.4				
5,000	S. 89°W.	7.0	N. 61°W.	12.4	N. 51°W.	11.3	N. 78°W.	14.2					W.	15.0	N. 6°W.	1.9	S. 22°E.	5.0	S. 80°W.	7.9				